

# Color separation in two-color printing

## Abstract

The book *Basisboek wiskunde* ('Basic Mathematics') by Jan van de Craats and Rob Bosch[1] was typeset in  $\text{\LaTeX}$  and submitted for printing as one big pdf-file. In this book one extra color (blue) was used for titles, headings, footings, important formulas, figures and also as a background color for certain pages or parts of text. Jan van de Craats, who did the typesetting, reports on a trick for obtaining color separation without flaws.

## Keywords

color, separation, printing

The typescript of our *Basisboek wiskunde* originally was prepared with a black and white text in mind. However, our publisher, Pearson Education Benelux, urged us to use one extra color to enliven the general appearance of the book. Since this publisher has no experience with  $\text{\LaTeX}$ , I had to figure out myself how to include color, of course with the help of Leslie Lamport's  $\text{\LaTeX}$  user's guide[2] and the  $\text{\LaTeX}$  *Graphics Companion*[3].



**Figure 1.** Color separation: full picture, cyan, and black components.

This in general went smoothly, but from a previous book with one extra color for which Wybo Dekker did the final typesetting, I knew that a problem might occur with black text on a colored background when the printing process is not done with the utmost precision. At color separation, two files are produced, one containing the portions to be printed with ink in the chosen color, and the other containing the portions to be printed in black. The latter is always printed last. So, for instance, when black text is to be printed on a blue background, first the blue background is printed with the black text left white, and then the text is superimposed (or rather, filled in) in black. See figure 1, where cyan was used instead of our color blue for reasons that will be explained later. This, however, requires a very accurate printing process. If the paper is not aligned properly during the second stage, very thin white 'shadows' might occur along with the

black letters. The *Graphics Companion* mentions this problem on page 348 and states that printers solve this by *trapping*, which means that the size of the colored areas is slightly increased. It doesn't say, however, how to achieve this in  $\text{\LaTeX}$ . Before explaining our simple trick that does the job in a different way, let me first devote a few words to color separation in general.

## Color separation

Color printing usually is a four step process, each page being printed four times with proportions of the basic colors *cyan*, *magenta*, *yellow* and *black*, respectively. Color separation from a source file consists in producing four distinct files in which the colors are separated so that, e.g., the *cyan* file only contains the proportions of cyan that should be printed. You can do color separation yourself using the *aurora* package together with *dvips*, as described in the *Graphics Companion* [2] on page 349. In this way I learned a lot about the separation process, although finally the color separation for our book was done directly from a (non-separated) pdf source file by the printing company.

In preparing a typescript with only two colors, black and one custom color, it is advisable to use one of the three basic colors cyan, magenta or yellow instead of the custom color. After color separation, the corresponding color file then can be used for printing with ink in the chosen color. In the  $\text{\LaTeX}$  source file for our *Basisboek wiskunde*, I took cyan, although a special kind of blue was used in the final printing. The printing company applied color separation to my file *BasisboekWiskunde.pdf* and used the resulting cyan and black component files for printing with blue and black ink, respectively. The (empty) magenta and yellow component files were left aside.

## Shades of color and overprinting

It should be noted that lighter shades of the chosen color can be obtained in much the same way as gray levels can be obtained in printing with black ink. For instance, you might want to use 100 percent blue for some colored text, 40 percent for a medium blue background color and 20 percent for a still lighter kind of blue. In the  $\text{\LaTeX}$ -file, where cyan is used instead of blue, this can be achieved (with the help of the *color* package) by defining colors *fullblue*, *mediumblue*, *lightblue* as follows:

```
\definecolor{fullblue}{cmyk}{1,0,0,0}
\definecolor{mediumblue}{cmyk}{.4,0,0,0}
\definecolor{lightblue}{cmyk}{.2,0,0,0}
```

(see also [3], page 132). Shades of color are specified by a number between 0 and 1, with 1 corresponding to full color and 0 to no color at all. Note that we use `definecolor` with `cmyk` as its first argument, specifying the `cmyk` color system. The four numbers in the second argument of the `definecolor` command correspond to shades of *cyan*, *magenta*, *yellow* and *black*, respectively.

Once you understand the `cmyk` color system and the principles of color separation, it is not difficult to come up with the following solution to the problem of avoiding white shadows. The trick is to define special colors ‘*black*’ corresponding to the chosen shades of background color (*cyan* in our code) as follows:

```
\definecolor{BlackOnFull}{cmyk}{1,0,0,1}
\definecolor{BlackOnMedium}{cmyk}{.4,0,0,1}
\definecolor{BlackOnLight}{cmyk}{.2,0,0,1}
```

Then, during the color separation process, any text that is set in one of these black colors is not only included in the black file, but also in the cyan file with the appropriate shade. Since this shade exactly matches its background color, it becomes invisible, filling completely the spaces that otherwise would have been left white for the letters! At the second (black) printing stage, the black text can be printed safely on this background without fear for white shadows.

For instance, the code

```
\setlength{\fboxrule}{3pt}
\fcolorbox{mediumblue}{fullblue}{%
\textcolor{BlackOnFull}{\{ \huge text \}}}
```

produces a framed box with inner color *fullblue* and a 3 pt frame in *mediumblue* containing ‘text’ in black. See figure 2, where also the color separation is given.



Figure 2. Color separation with our overprinting trick.

It should be noted that our trick works fine since black is used as overprinting color. The color black absorbs all light, even when printed on a colored background. When using a different color for overprinting, the two colors might interfere, and our trick might produce undesired effects. I have no experience in this respect, and would welcome any other solution.

## References

- [1] Jan van de Craats and Rob Bosch. *Basisboek Wiskunde*. Pearson Education Benelux (2005). ISBN 90-430-1156-8.
- [2] Leslie Lamport. *LaTeX: A Document Preparation System. User’s Guide and Reference Manual*. Addison-Wesley, 2nd edition (1994). ISBN 0-201-52983-1.
- [3] Michel Goossens, Sebastian Rahtz, and Frank Mittelbach. *The LaTeX Graphics Companion*. Addison-Wesley (1997). ISBN 0-201-85469-4.

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